GEWEX MODELING PROGRAM

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The energy and hydrology cycles are inherently coupled in the Earth's climate system, The Global Energy and Water Cycle Experiment (GEWEX) is planned to observe and understand the hydrological cycle and energy fluxes in the atmosphere, at land surfaces and in the upper ocean layers. ‘l’he ultimate aim of the GEWEX modeling program is to predict variations of the global hydrological regimes, including changes in regional trends of water resources and their response to changes in the environment clue to increasing greenhouse gases. Current models are inadequate. Existing short-range (weather) forecasting models are rather primitive in their ability to predict the phase changes and transport of water in the atmosphere. The problem is more serious when it comes to long-range (seasonal and interannual) prediction models with coupled atmosphere, upper ocean, and land hydrology components. The GEWEX program needs both types of models for two separate reasons: prediction and data assimilation.

improving current short and long-range models to the level needed to determine global water and energy fluxes will require considerable improvement in the descripti on of the physical processes such as moisture-cloud-radiation interactions, land surface-vegetation feedbacks and air-sea exchanges. A major difficulty arises because these processes, which must be integrated together in climate models, are basically nonlinear and invariably function over widely different scales in space and time. For example, land surface vegetation processes require a microscale grid size of less than 1 x 1 km, catchment studies employ grid sizes of 10 x 10 km, and ocean eddies require grid si zes of 100 x 100 km. These processes must be integrated with a GCM currently having grids between 100 x 100 km and 500 x 500 km. in addition, GEWEX will need short-range forecasting models to produce coherent data sets from incomplete observational data. Various observational data are assimilated in time and space by three models to provide a short-range forecast which can then be used to construct global, complete and self-consistent descriptions of the observed state and to provide time and space continuity and give an estimate of the characteristics of some of the parameters not directly measured. ‘l’he lack of reliable global data is recognized as the most critical deficiency in modeling the hydrological cycle.

Achieving this will require advances on three fronts: (1) we must improve our understanding of the physics, chemistry and dynamics of processes themselves, which requires accurate observations and field experiments, (2) wc must resolve the problem of scales of great natural inhomogeneity (this fundamental statistical-dynamical problem remains basically unsolved) and (3) we must translate the results of individual process studies to the global scale models.